The Office of Environment, Safety and Health and its Office of Nuclear and Facility Safety (NFS) publishes the Operating Experience Weekly Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging feedback of operating experience and encouraging the exchange of information among DOE nuclear facilities.

The Weekly Summary should be processed as an external source of lessons-learned information as described in DOE-STD-7501-96, *Development of DOE Lessons Learned Programs*.

To issue the Weekly Summary in a timely manner, the Office of Operating Experience Analysis and Feedback (OEAF) relies on preliminary information such as daily operations reports, notification reports, and, time permitting, conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, 301-903-4094, or Internet address jim.snell@hq.doe.gov, so we may issue a correction.

Readers are cautioned that review of the Weekly Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

Operating Experience Weekly Summary 97-23

May 30 through June 5, 1997

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EVENTS

1. CORRODED END FITTING RESULTS IN DROPPED FUEL ASSEMBLY

On May 31, 1997, at the Savannah River Site K-Reactor, operators were transferring an aluminum-clad fuel assembly from a storage hanger to a vertical disassembly machine when the assembly dropped from the gripper tool. The bottom of the assembly came to rest under the vertical disassembly machine. The top came to rest on an underwater column, tilted at 60 degrees. Operators recovered the fuel assembly in accordance with an approved response plan. They inspected the assembly with an underwater video camera and discovered corrosion around the lip engaged by the fuel gripper tool. The facility manager placed all fuel movement on hold until they developed a corroded-fuel transfer method. Dropped fuel assemblies can result in fuel assembly damage, release of fission products, or accidental criticality. (ORPS Report SR--WSRC-REACK-1997-0006)

An operator engaged the fuel assembly with the gripper tool and shook it to ensure the tool was engaged. Three mechanical fingers on the gripper tool make a positive lock into a machined groove (lip) on the inside diameter of the upper-end fitting. Investigators determined that a corroded section of the lip broke away at one of the three fingers, causing the assembly to swing in the direction of the other two and drop away. The facility manager reported the direct cause of the event as equipment/material problem (defective or failed material).

The facility manager directed operators to conduct an assembly-by-assembly inspection to identify other potential corrosion-related problems with the fuel assemblies. Operators drafted a new procedure with fewer handling steps. The new procedure also designates use of a tool designed to grip the assemblies on the outside diameter, further down the assembly, where corrosion would be minimal. With this tool, operators can transfer the assemblies from the vertical position to the horizontal position to perform the disassembly process. Operators are conducting a dry-run of the new procedure using a dummy assembly.

NFS reported dropped fuel events in Weekly Summaries 96-06, 94-49, 94-42, 93-36, 93-31, and 93-27. NFS also reported fuel-corrosion issues in Weekly Summaries 94-42, 93-09, 92-33, 92-22, and 92-11.

- Weekly Summary 96-06 reported that on January 31, 1996, at the Savannah River Site, component handlers dropped a fuel bundle while transferring fuel assemblies in the K-Reactor disassembly basin. The fuel bundle separated from the twin-hook hoist and came to rest on top of a storage rack with two stored fuel bundles. Investigators determined that a previously identified corrective action item to place all hoists on a preventive maintenance schedule had not been implemented. Worn bushings on the yoke of the twin-hook hoist contributed to the fuel bundle drop. (ORPS Report SR--WSRC-REACK-1996-0002)

- Weekly Summary 92-33 reported that on November 25, 1992, at the Savannah River Site, DOE personnel observed extensive corrosion at the end fittings on fuel assemblies during visual inspections of the L-Reactor disassembly basin. Investigators determined that, if the corrosion were severe enough, the end fitting could fail, causing the fuel assembly to drop. (ORPS Report SR--WSRC-REACL-1992-0032).

This event emphasizes the need to consider (1) the effects of corrosion on stored spent fuel, (2) the design of fuel storage facilities, and (3) the need for a DOE-wide fuel policy to deal with the range of spent fuel problems across the complex. Corrosion of spent reactor fuel not only affects the integrity of the fuel cladding, leading to possible fission product release, but increases the risk of a fuel-handling accident because of degraded lifting points. Galvanic corrosion can occur when dissimilar metals come in contact in an electrically conductive aqueous solution. Operating with proper water chemistry is also an important factor for limiting corrosion. In addition, periodic inspections of equipment and supporting structures are essential to maintaining adequate material integrity.

The DOE Spent Fuel Working Group issued a three-volume report in November 1993, on the inventory and storage of spent nuclear fuel. The report contains additional information on corrosion problems at DOE spent fuel storage facilities. Volume II contains the working group assessment team reports for Savannah River Site. Attachment 4 discusses corrosion and chemistry considerations for aluminum-clad fuel and target slugs. The report can be accessed through the ES&H Technical Information Services Home Page at http://tis.eh.doe.gov/docs/spent_fuel.html.

KEYWORDS: fuel assembly, corrosion

FUNCTIONAL AREAS: Operations, Nuclear/Criticality Safety

2. TEMPORARY PUMP INSTALLATION RESULTS IN UNREVIEWED SAFETY QUESTION

On May 29, 1997, at the Hanford K-Basins West, facility managers declared an Unreviewed Safety Question (USQ) discovery because a temporary pump and flexible hose could siphon water out of the basin after a postulated design basis earthquake. Workers immediately removed the hose and eliminated the siphon potential. A subsequent engineering analysis revealed that K-Basins had been in a USQ condition for approximately 2 years. Investigators determined that the work controls and safety evaluation for the temporary pump installation were inadequate. Failure to provide appropriate work controls for the temporary modification resulted in the USQ and lowered the margin of safety. (ORPS Report RL--PHMC-KBASINS-1997-0008)

Investigators determined that the pump was originally installed in May 1995. Maintenance workers installed the pump to circulate water from the basin into the discharge chute area to maintain water clarity (see figure 2-1). In May 1997, engineers determined that in the event of a design basis earthquake, the pump could detach from its support and fall to the bottom of the basin. They also determined that if the pump was operating before a postulated design basis earthquake and the flexible hose broke off, it could create a siphon condition that would transfer water out of the basin. This type of accident had not been analyzed.

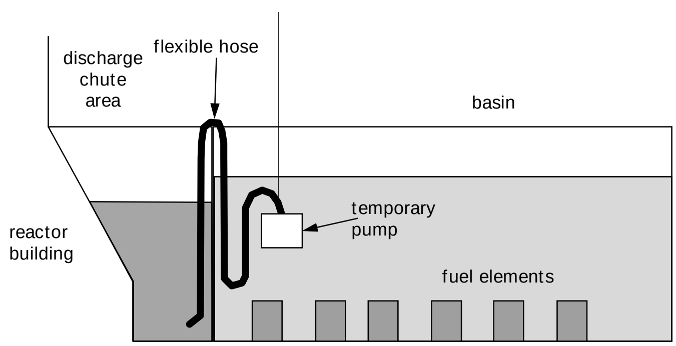


Figure 2-1. Side View of the Temporary Pump Configuration

Investigators determined that maintenance workers originally installed the pump using a routine work request that was inappropriate for this type of temporary modification because the safety evaluation was inadequate for proposed work. The installation should have been performed using a temporary modification package. Facility personnel are evaluating the work controls program to determine when routine work requests are appropriate and when temporary modification packages should be used.

An event with a similar inappropriate use of work requests, but more tragic consequences, occurred at the Los Alamos National Laboratory Tritium Salt Facility on January 17, 1996. A mason tender received a severe electrical shock that resulted in serious burns and cardiac arrest. The mason tender was excavating in a building basement when the jackhammer he was operating contacted an energized 13.2-kV electrical cable. (Weekly Summaries 96-04 and 96-05; Type A Accident Investigation Board Report on the January 17, 1996, Electrical Accident with Injury in Building 209, Technical Area 21, Los Alamos National Laboratory; ORPS Report ALO-LA-LANL-TSF-1996-0001) A Type A Accident Investigation Board identified numerous issues associated with the accident, including the fact that Los Alamos workers used an inappropriate work request for the excavation work. Major construction activities, such as the basement excavation, should have been accomplished under a detailed specialized work request. Instead, workers used a standing work order for routine maintenance tasks. According to administrative procedures, standing work requests do not require comprehensive safety evaluations because they are for routine, repetitive, non-complex tasks.

These events underscore the importance of effective work control programs for work planning and appropriate use of these programs. DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling and Coordination of Maintenance at DOE Nuclear Facilities*, section 3.1.2, states that a priority coding system for maintenance job requests should be established. The standard also provides guidance on different priority codes and discusses the need for thorough reviews of work packages by experienced individuals to eliminate errors.

DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, “Control Of Equipment and System Status,” states that managers of DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing. "Temporary Modifications," paragraph C.9, specifies that administrative control systems should be established for installation of electrical jumpers, lifted leads, pulled circuit boards, disabled annunciators/alarms, mechanical jumpers/bypasses, temporary setpoint changes, installed or removed filters or strainers, plugged floor drains, and temporary pipe supports. DOE-STD-1039-93, *Guide to Good Practices for Control of Equipment and System Status*, states that special administrative controls are required when equipment is operated with temporary modifications (e.g., jumpers, blocks, bypasses). Section 3.1.2 states that a priority coding system for maintenance job requests should be established and provides guidance on different priority codes.

NFS issued DOE/EH-0345, Safety Notice 93-02, “Control of Temporary Modifications,” in September 1993. The notice recommends actions to mitigate hazards associated with temporary modifications. Included are recommendations to ensure that all individuals understand anticipated conditions, comply with procedures, and adhere to safety requirements. Safety Notice 93-02 can be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: work package, temporary modification, pump, fuel pool

FUNCTIONAL AREAS: Configuration Control, Work Planning, Mechanical Maintenance

3. INCORRECT VALVE LINEUP CAUSES INADVERTENT TRANSFER OF SOLUTION

On May 30, 1997, at the Savannah River Site, operators inadvertently transferred solution from the wrong cation concentrate batch tank to a precipitator feed tank. While performing a valve lineup, an operator accidentally read steps from the wrong page (for a sister tank) of a procedure and transferred some solution from the correct tank and some from the wrong tank. When the operators realized their mistake, they repositioned the misaligned valves. The operators stopped the transfer but did not inform management of the error. An engineer discovered the depletion of solution from the batch tank during a review of the facility material control and accountability procedures. Inadvertent transfers of solutions can result in the mixing of incompatible chemicals or solutions, tank overflows, contamination of clean systems, and criticality safety implications. (ORPS Report SR--WSRC-FBLINE-1997-0019)

The facility manager conducted a critique and learned that operator error was the cause of the depleted inventory. During the critique, the operators stated that they did not inform management of the valve misalignment because they did not consider it to be a problem. The operators were disqualified pending remedial training. They should have stopped the evolution and notified supervision immediately after recognizing the error so that any safety implications could be evaluated before proceeding. Although the inadvertent transfer was not significant from a safety standpoint, the solution that came from the wrong tank did not have the desired concentration for the process.

Investigators determined that the operators did not monitor the tank level changes on the strip chart recorders during the transfer and that some of the operators did not have a copy of the procedure. They used the “reader-worker” method, with one operator reading the procedure and instructing the operator performing the valve lineup. Investigators also determined that not all of the participants working on the transfer attended the pre-job briefing. Attending the briefing might have made everyone aware of the correct tank for the transfer.

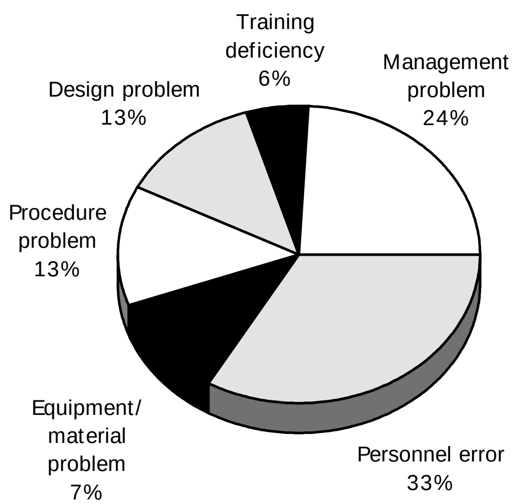
A similar event occurred on October 24, 1994, at Savannah River, where operators failed to report a valving error. An operator misread a valve label and opened the wrong valve, adding 16 liters of process water to the wrong tank. The operator did not report the error during shift turnover, nor did he record it in the watch-stander log. Investigators determined the direct and root cause of the event was inattention to detail. The operator should have stopped at the step where the inadvertent transfer took place. (ORPS Report SR--WSRC-HBLINE-1994-0022)

NFS reported inadvertent solution-transfer events in Weekly Summaries 97-08, 96-14, 96-13, 96-09, 96-01, 95-51, 95-27, 93-46, and 93-10.

- Weekly Summary 96-14 reported that on March 28, 1996, at the Savannah River Site, during a valve lineup, operators inadvertently transferred hydrofluoric acid to a precipitator because they did not follow procedure steps in the required sequence. (ORPS Report SR--WSRC-FBLINE-1996-0016)

- Weekly Summary 96-13 reported two events at the Savannah River Site, where operator inattention to detail resulted in the inadvertent transfer of nitric acid solution. On March 20, 1996, an operator failed to close the outlet valve of a head tank and allowed 2,200 pounds of nitric acid to transfer to a dissolver before the specific gravity of the acid was verified. The second event occurred on March 25, 1996, when an operator opened a tank drain valve allowing 600 pounds of nitric acid to transfer to a waste header while performing a valve lineup for a frame waste recovery run. Investigators determined that operator inattention to detail and procedure violation contributed to these events. (ORPS Reports SR--WSRC-FCAN-1996-0005 and SR--WSRC-HCAN-1996-0009)

Operating Experience Analysis and Feedback (OEAF) engineers reviewed the Occurrence Reporting and Processing System (ORPS) database for reports involving inadvertent transfers of solutions and found 55 occurrences. Figure 3-1 shows the distribution of root causes reported by facility managers for these events. Personnel error represented 33 percent of the root causes and management problem, 24 percent. Procedure not used or used incorrectly accounted for 44 percent of the personnel errors, and inadequate administrative control accounted for 54 percent of the management problems.



Personnel Error	**Percent**
Procedure not used or used incorrectly	44
Inattention to detail	39
Communication problem	11
Other human error	6

Management Problem	**Percent**
Inadequate administrative control	54
Work organization/planning deficiency	23
Policy not adequately defined or enforced	15
Inadequate supervision	8

Figure 3-1. Distribution of Root Causes for Inadvertent Transfer of Solutions[1]

Inadvertent transfers create several major areas of concern. For example, solutions containing fissile materials may be subject to inadvertent criticality. Also, for many solutions, there are concerns about reactions between incompatible chemicals. These reactions may result in generating explosive, corrosive, or gas-generating mixtures. Another area of concern is the potential for off-site release of radiation or hazardous chemicals.

DOE Defense Programs Safety Information Letter, SIL 95-05, *Inadvertent Transfer of Liquid Solution,* June 1995, addresses safety problems resulting from inadvertent transfers of solutions. The SIL includes the following recommendations regarding liquid transfers.

- Use procedures—The proper use of procedures reduces the chance of unexpected results.

[1] OEAF engineers searched the complete ORPS database using all narrative “inadvertent AND transfer@ AND solution@ OR liquid@” and found 123 occurrence reports. A 100 percent review of these reports yielded 55 events.

- Verify Lineups—Checking system alignment should guarantee the solution goes to the expected location. All lineups should be physically walked down and checked against facility documentation to identify any discrepancies.
- Hold detailed briefings—Conduct a detailed briefing with all parties involved in the event before test activities or unusual operations. Ensure each person understands what is expected and what actions to take if something unexpected happens. The briefings should identify important parameters and instrumentation to be monitored.
- Perform one task at a time—Ensure each evolution is complete and parameters stabilized before beginning another task, if the situation allows.
- Prepare contingency plans—When preparing for any evolution think about what may go wrong and for each instance ensure guidance is provided to mitigate that event. Include identification of parameters and instrumentation that would indicate an unusual event is occurring.

Personnel at DOE facilities can obtain a copy of SIL 95-05 by contacting Tom Rotella, Defense Programs, Office of Engineering, Operations, Security, and Transition Support, at (301) 903-2649.

KEYWORDS: procedures, operations, tank, transfer

FUNCTIONAL AREAS: Operations, Chemistry, Procedures

4. CRANE TIPS WHILE LIFTING LOAD AT HANFORD

On May 30, 1997, at the Hanford Tank Farms, a 30-ton mobile, hydraulic crane lifting a 4,600-pound steel trench box tipped, and the boom landed on a 10-foot mound of dirt. The crane came to rest against the mound at a 45-degree angle. The crane operator and an assisting flagman were not injured. Investigators determined that the crane operator failed to extend all four outriggers as required for this type of lift. Loss of control of the crane could have caused equipment damage or personnel injury. (RL--PHMC-TANKFARM-1997-0048)

A subcontractor had excavated a trench and shored it with the steel trench box sections while installing a new underground transfer line. When the excavators were finished installing the line, the crane operator used the crane to pick up the trench boxes and stack them for removal. Investigators determined that the operator extended the front two outriggers of the crane, but failed to extend the rear two, when preparing to lift the sections. A typical hydraulic crane, displaying the outrigger configuration, is shown in figure 4-1. The operator picked up the load and extended the boom. As he rotated the load to the side of the crane, the crane fell against the mound of dirt (see figure 4-2). The operator shut down the crane and exited without injury.

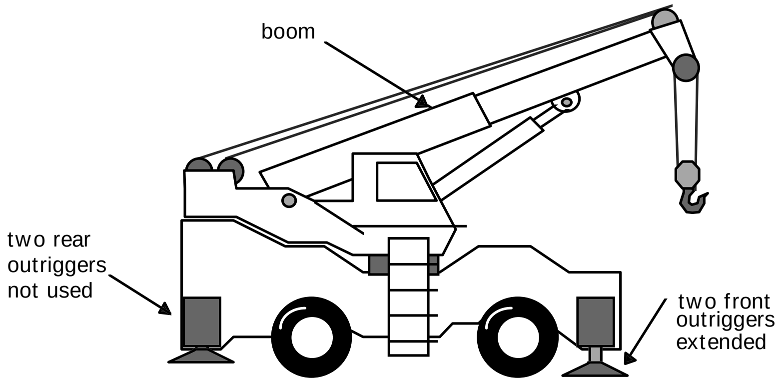


Figure 4-1. Typical Hydraulic Crane

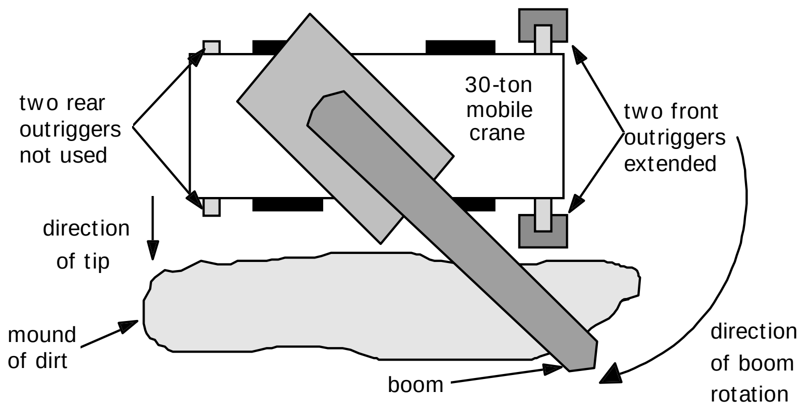


Figure 4-2. Top View of the Hydraulic Crane Showing the Direction of Tip

Investigators determined that the load rating chart for the crane permitted lifts without extended outriggers. However, the allowable load, boom angle, and extension are greatly reduced. The load chart does not address operating the crane with only two outriggers extended. According to the load chart, the capacity and geometry of the lift were acceptable with all outriggers extended. Investigators determined that the crane operator failed to properly configure the crane for the lift.

NFS reported a similar event involving a crane tipping in Weekly Summary 96-42. On October 9, 1996, at Oak Ridge, a 27.5-ton mobile, hydraulic crane lifting a 12,810-pound load over a concrete wall tipped until the boom struck the wall. No one was injured. According to the occurrence report, the direct cause of the accident was that the crane was overloaded for the configuration used (load weight, boom extension, and boom angle). (ORPS Report ORO--LMES-K25CM-1996-0001)

These events illustrate the hazards caused by failing to adequately prepare for mobile crane lifts. Crane operators must be qualified and knowledgeable about how to properly set the outriggers, including setting outriggers on different structural materials. Operators must ensure that all safety requirements are met and should request assistance from the appropriate manager when an operation appears to be unsafe. DOE-HDBK-1095-96, rev. 1, *Hoisting and Rigging Handbook,* chapter 9, specifies operation, inspection, maintenance, and testing requirements for mobile cranes. Section 9.5.1.3 provides guidance on ensuring the stability of cranes. The guidance includes the following instructions.

- Know the capacity of the crane and the weight of the load. A safe lift depends on many factors, including boom length, boom angle, and load radius.
- Crane ratings are based on operating the machine on firm, level ground; outriggers should be properly extended and lowered before operation.
- Avoid fast swings, hoists, or sudden braking; these can cause overloads.
- Always fully extend outrigger beams unless otherwise specified on the manufacturer's load charts for the crane.
- Test stability before lifting heavy loads. Check outrigger footing. Lift the load slightly off the ground and stop. Check the machine for movement and check to make sure the brakes hold with the load elevated.

Included at the end of Chapter 9 of the handbook is a sample checklist to ensure mobile crane lifts are safe and performed without incident. Managers at DOE facilities that use mobile cranes should review the sample checklist for possible incorporation into their hoisting and rigging programs.

KEYWORDS: crane, rigging, fall, loads

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety, Construction

5. PROCEDURE VIOLATIONS FOR RECEIPT AND USE OF CARBON-14

On May 5, 1997, at Lawrence Berkeley National Laboratory, a researcher received ten times the authorized quantity of Carbon-14 in a shipment from the University of California Berkeley campus in violation of written radiological work authorization procedures. Investigators believe that the researcher requested 0.1 millicuries of Carbon-14. However, the shipment's packager either misinterpreted the request or assumed the amount was 1 millicurie. Possession of 1 millicurie of Carbon-14 violated the radiological work authorization limit for the researcher's activity. Violation of procedures and possession of unauthorized amounts of radioactive isotopes create the potential for the uncontrolled spread of contamination. (ORPS Report SAN--LBL-CSD-1997-0001)

While attending a training course on the Price-Anderson Amendment Act, the researcher realized potential violations had occurred. During the training course, she self-reported the excess amount of Carbon-14 in her possession to a health physicist. The health physicist initiated notifications and categorizations for the event. The researcher was not aware of the link between the Occurrence Reporting and Processing System (ORPS) requirements and the self-reporting requirements of the Price-Anderson act before the training course. Investigators continue to investigate this event to determine the appropriate corrective actions.

A similar event occurred on February 26, 1997, at Lawrence Berkeley National Laboratory, when a researcher ordered and received orthosphosphate P-32 without authorization. Investigators determined the person who received the shipment misread the manifest and thought the quantity, listed as 1 (for 1 vial), was the radioactivity of the material (1 millicurie). The vial actually contained 10 millicuries of P-32. This resulted in the researcher having ten times the authorized quantity of the radioisotope. Investigators stated that corrective actions have not been completely implemented for this event. Timely implementation of the corrective actions may have prevented the May 5, 1997 event. (ORPS Report SAN--LBL-LSD-1997-0002)

Operating Experience Analysis and Feedback (OEAF) engineers reviewed the ORPS database for procedures not used or used incorrectly and for loss of control of radioactive material and found 108 occurrences. Figure 5-1 shows the contributing causes for these events across the DOE complex. Personnel error represented 34 percent of the contributing causes, with 54 percent of personnel error attributed to inattention to detail. Management problems represented 25 percent of the contributing causes, with 37 percent of management problems attributed to inadequate administrative control and supervision and 30 percent attributed to policy not adequately defined, disseminated, or enforced.

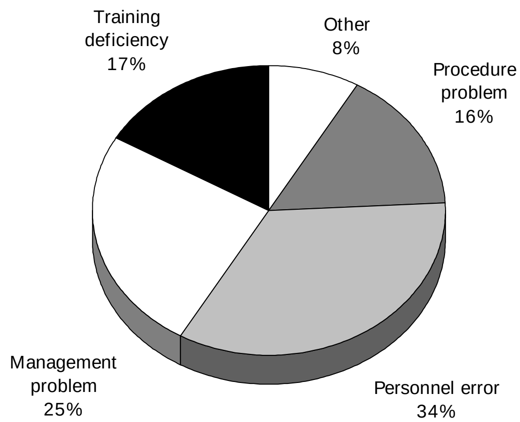


Figure 5-1. Distribution of Contributing Causes for Loss of Control of Radioactive Material Procedure Violations[1]

These events underscore the importance of having trained and qualified personnel in the laboratory. Laboratories contain open flames, hazardous chemicals, and radioactive materials. Laboratory personnel should be able to demonstrate their proficiency with safe laboratory practices and their knowledge of laboratory procedures, including governing regulations. The fact that the researcher was unaware of regulations emphasizes the need for laboratory training and management oversight. However, the fact that training caused the researcher to realize potential violations and self-report proves training can be an effective tool for communicating regulations.

U.S. National Research Council publication ISBN 0-309-05229-7*, Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, 1995, states: "While the experiments may be prepared and conducted by the laboratory workers, it remains the responsibility of the laboratory supervisor to determine what level of experiment planning is appropriate and to be accountable for necessary training, documentation, and compliance with regulations." DOE STD-7501-95, *Development of DOE Lessons Learned Programs*, discusses management's responsibility for incorporating appropriate corrective actions in a timely manner.

KEY WORDS: laboratory, training and qualifications, transportation

[1] OEAF engineers screened the ORPS database for contributing cause codes "1d" (loss of control of radioactive material) and "3b" (procedure not used or used incorrectly) and found 108 reports. Based on a random sample of 30 reports, OEAF engineers determined that each pie chart slice is accurate within ± 2.7 percent.

FUNCTIONAL AREAS: Radiation Protection, Training and Qualifications, Materials Handling/Storage